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TOP DOWN FUNCTIONAL ANALYSIS (TDFA) FOR HUMAN SYSTEM INTEGRATION

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Purpose

Present Top Down Functional Analysis (TDFA) approach to HSI in DoD system design process through its system engineering discipline.

Key Definitions

- ***System Engineering*** **is interdisciplinary DoD engineering management process to evolve and verify system solutions for user needs**
  - Incorporates user needs from DoD joint warfighting capabilities with UJTLs-METLs
  - Capabilities transformed into system performance parameters for acquisition system design development

- ***Missions*** **describe unit or organization goals and activities using human + technology capabilities**
  - Combatant Commanders (users) and Services essential tasks to accomplish their missions

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Key Definitions (Continued)

- ***Functions*** **describe activities to be performed by system to execute user missions - system performance baseline**

- ***Tasks*** **describe qualitative and quantitative workload of individual system operators and maintainers - human performance baseline**

- ***Human Tasks*** **are derived through human engineering, acquisition logistics, training, system engineering task analysis practices**

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Mission-Function-Task Performance Hierarchy

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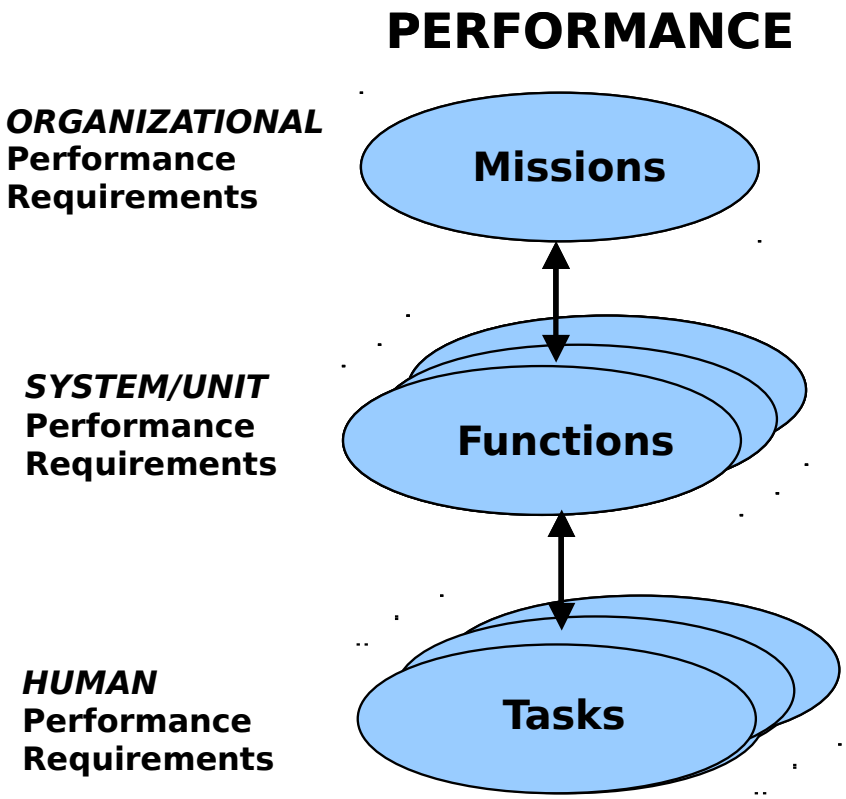

Missions/UJTLs-METLs
- NTA 2.2.3 Process Targets

Operational Processes/Eqpt/Orgs
- Mission Phase: Conduct Air to Surface Weapons Delivery/Attack
- System Function: Deliver Weapons

Individual/Team/Collective Tasks
- 07C.009: Employ SLAM
- 07T.031: Employ General Purpose Bombs
- 07C.010: Employ Harpoon

Capstone Guidance

- **DoDD 7730.65 - "DoD Components shall develop mission essential tasks for all assigned missions and collect near real-time data on readiness of military forces to perform their missions."**
  - UJTLs and METLs with mission analysis describes Combatant Commander (COCOM) requirements in universal language
  - Mission focus creates task requirements/standards to measure operational warfighting readiness

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Capstone Guidance (Continued)

- **CJCSI 3170.01C "Joint Capabilities Integration and Development System - JCIDS"**
  - Process defines policies and procedures to identify, assess and prioritize joint military capability needs
- **DoD Strategic Plan for Transforming Training**
  - Transformation links Joint and Services military training to COCOM mission requirements
    - Includes acquisition and fielded weapon systems

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Impact on DoD Acquisition Programs

- **Employment of mission-based, integrated HSI-System Engineering process with program performance baseline management**

- **Navy's Solution: TDFA Methodology**
  - Cross-discipline, performance-based system requirements definition and design process
  - Decomposes COCOM's mission requirements with UNTLs-NMETLs to human system tasks
  - Provides mission-human resources audit trail

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Why TDFA?

- **Formal system design process consistent with DoD approach to System Engineering (SE)**
  - Integrates human performance requirements and processes with system design process
  - NAVSEA HSI toolbox component
- **Supports system HSI program influence early in design development**
- **Measures HSI impacts from design decisions**

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TDFA Objective and Approach

- **<u>Objective</u>: Translate system performance requirements into detailed functional and human performance criteria for HSI baseline**
  - ORD/CDD, CONOPs, KPPs, etc.

- **<u>Approach</u>: "Top Down" mission decomposition analysis for system performance requirements from user capabilities**
  - Missions flowed down through system functions to individual performance requirements - <u>human tasks</u>

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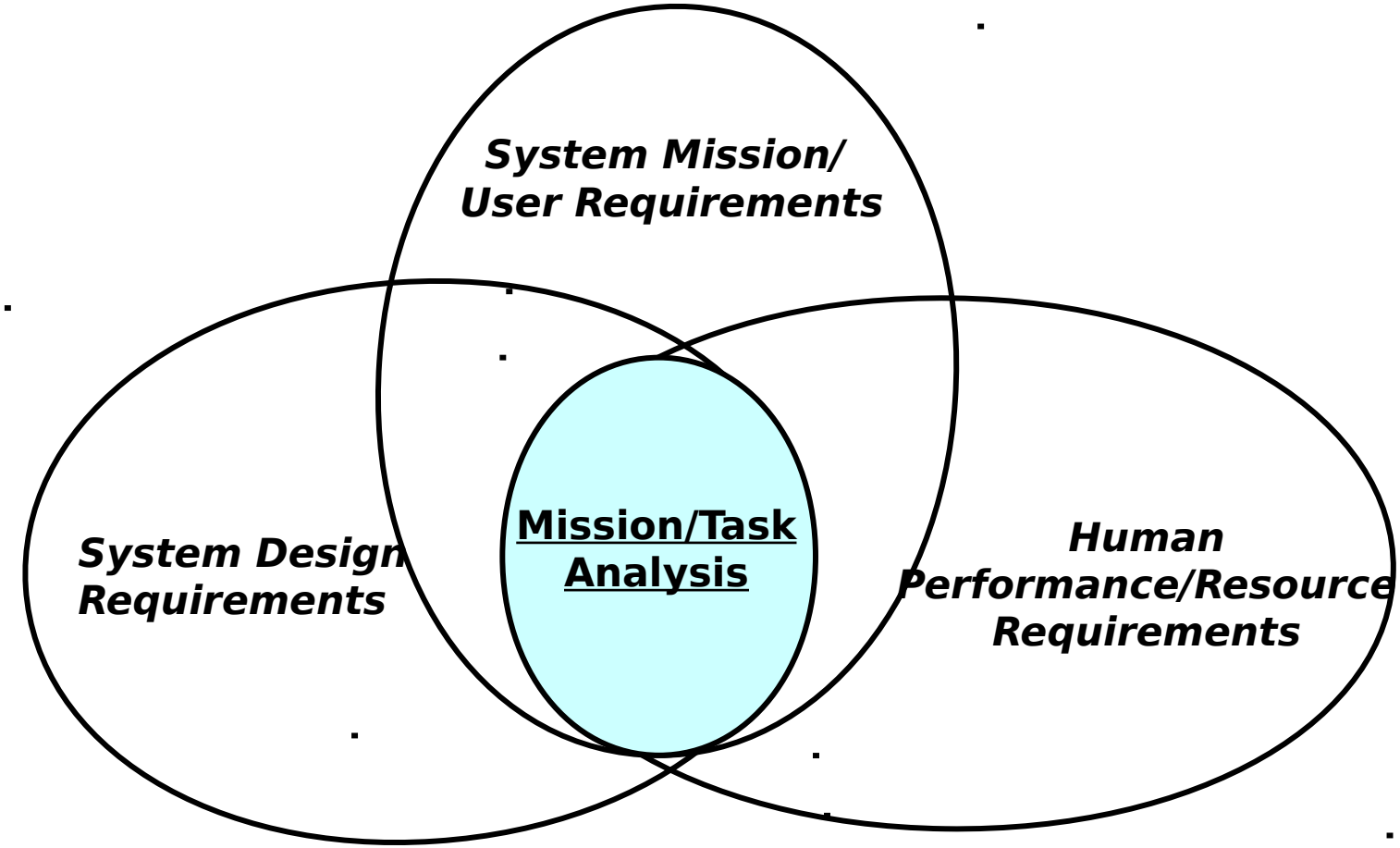
Common HSI Mission/Task Core



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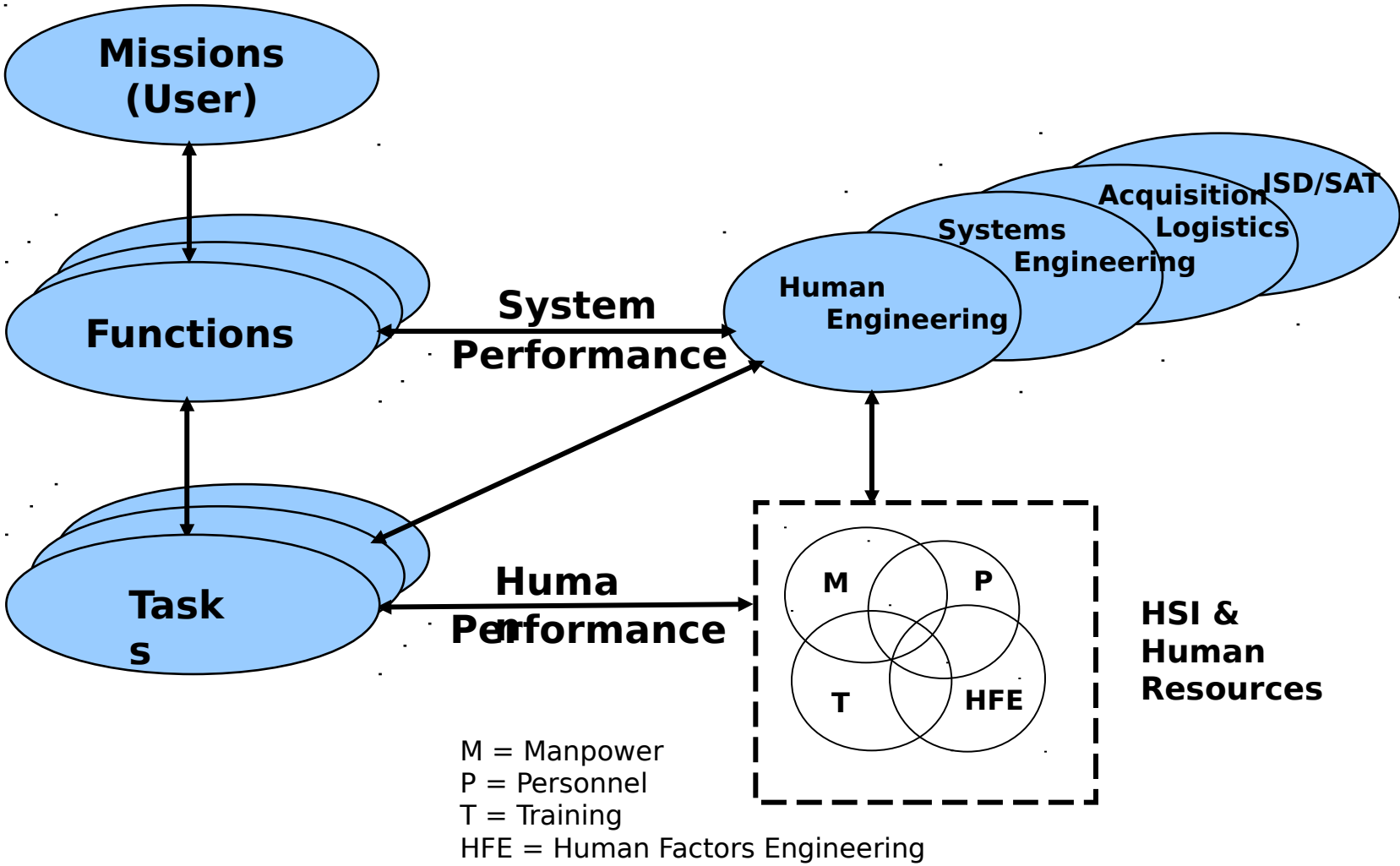
TDFA Linkage to HSI and System Acquisition Disciplines



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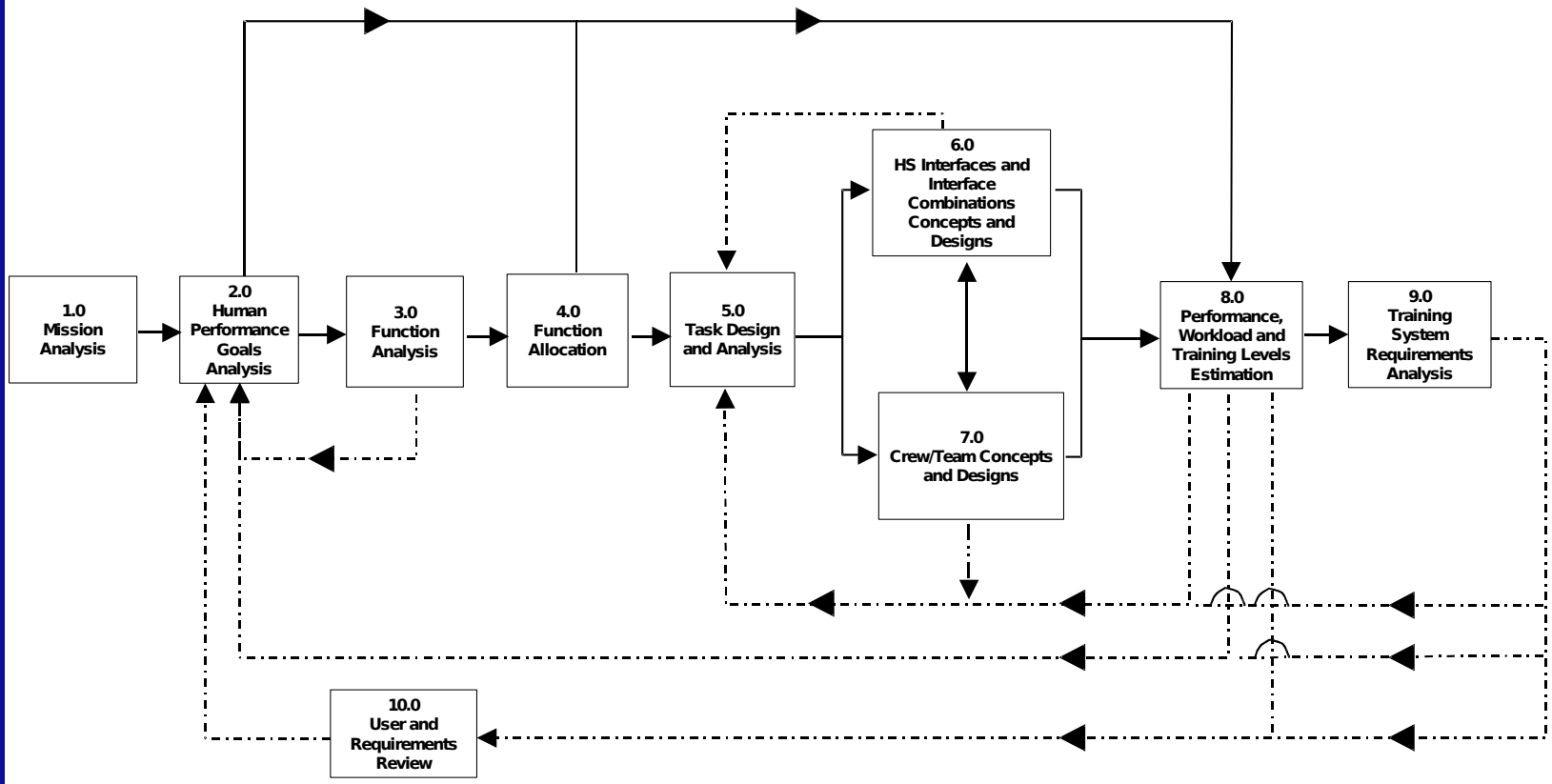
TDFA Process



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TDFA Products

- System METs
- System MOEs
- Scenarios
- Task Model
- Functional Architecture
- Function Allocation

- Personnel Selection Criteria
- Manpower Requirements
- Training Strategy/Concepts
- Human Performance Requirements

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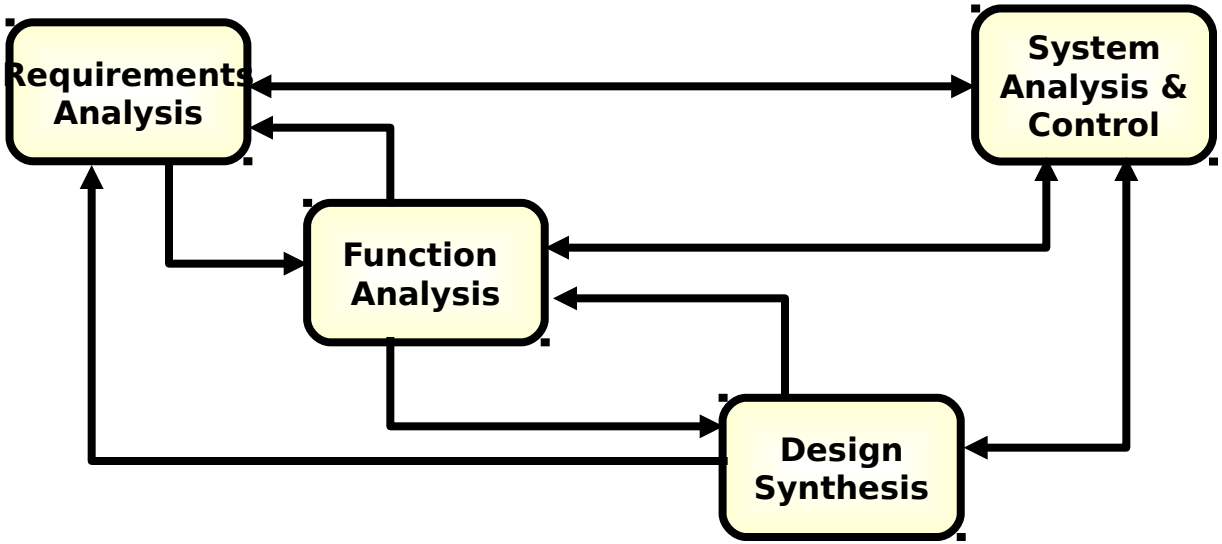
SE Process



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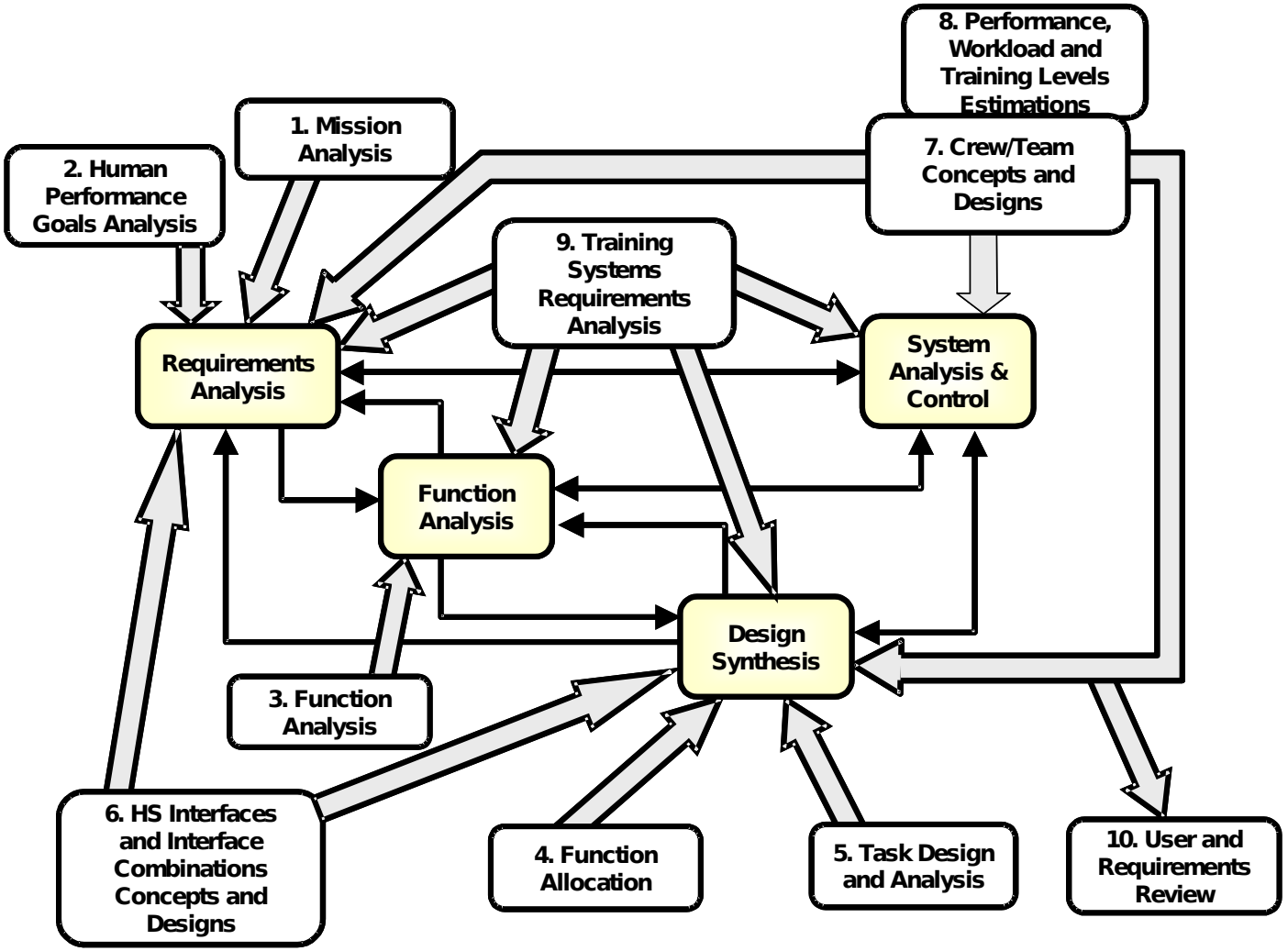
TDFA: HSI Window into SE Process (TDFA and SE Relationship)


8. Performance, Workload and Training Levels Estimations
1. Mission Analysis
2. Human Performance Goals Analysis
7. Crew/Team Concepts and Designs
9. Training Systems Requirements Analysis
Requirements Analysis
System Analysis & Control
Function Analysis
Design Synthesis
3. Function Analysis
6. HS Interfaces and Interface Combinations Concepts and Designs
4. Function Allocation
5. Task Design and Analysis
10. User and Requirements Review

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TDFA is Lifecycle Process

- **Do it Early:**
  - Initial program MPT resource estimates
  - Potential HSI issues and high drivers
  - Design influence at Milestone A
- **Do it Often:**
  - Evolving human system performance model
  - Iterative for system design/supportability decisions

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Summary

- **TDFA facilitates integration of HSI criteria with SE process to influence design development and program decision-making**
  - Translates system performance requirements into human system performance baseline
  - Links human task performance to Service METLs to implement DoD directives that focus on system performance and warfighting readiness for COCOMs

- ***<u>Bottomline</u>: Mission-task focus is core of TDFA methodology to link COCOMs success to human capabilities.***

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Back Ups

TDFA Methodology

10-Step TDFA Process:

- 1) Mission Analysis; 2) Human Performance Goals Analysis; 3) Function Analysis; 4) Function Allocation; 5) Task Design and Analysis; 6) HSI and Combination Concepts and Designs; 7) Crew/Team Concepts and Designs; 8) Performance, Workload and Training Level Estimation; 9) Training Systems Requirements Analysis; and 10) User and Requirements Reviews

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Step 1 - Mission Analysis

- **Objective: Determine acquisition system required capabilities and missions**
  - Operations Templates, Requirements Documents, UJTL Tasks, Comparable Systems Analysis and SMEs

***Products*: System mission objectives and needs**

UNTL - Universal Joint Task List

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Step 2 - Human Performance Goals Analysis

- **Document known human system performance requirements**
- **Activities:**
  - Extract human performance/human resource goals and requirements from system requirements documents
    - Manpower Constraints, Personnel Qualifications, KPPs, etc.
  - Identify policy-based human resource guidelines
    - Manpower Caps, NEC/MOS Policy, Standards of Grade, etc.
  - Identify human performance and human resource constraints
    - Anthropometrics, Aptitudes, Prerequisites, etc.

***Product*: Identify human system performance requirements, such as manpower goals/sources, physical constraints, etc.**

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Step 3 - Function Analysis

- **Describes what system must do to accomplish mission requirements:**
  - Translate/allocate system requirements to functional architecture to define activities system will perform to meet mission requirements
- **Activities:**
  - Assess system functions
  - Develop/expand functional flow
  - Develop/expand functional architecture

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Step 4 - Function Allocation

- **Assigns system functions to humans (operators and maintainers) and/or design technology of system**

- **Activities:**
  - Identify operator and maintainer capabilities and limitations
  - Identify human engineering technology capabilities and limitations
  - Allocate mandatory functions
  - Allocate by other criteria

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Step 5 - Task Design and Analysis

- **Describes unit of work performed by humans and how they will perform assigned functions at task level**

- **Activities:**
  - Identify human tasks from system functions
  - Identify task characteristics, sequence, interactions
  - Create task model

***Product*: Task model with task list and task characteristics**

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Step 6 - Develop Human Interface and Interface Combination Concepts and Designs

- **Provide specific location/interaction for each task and crew - individually and collectively**

- **Activities:**
  - Identify human/system interface points
  - Identify human guidelines
  - Develop interface concepts and designs
  - Identify interface-specific tasks

<u>Products</u>: Identification and description of human system interfaces and revised task list

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Step 7 - Develop Crew/Team Concepts and Designs

- **Aggregate workload by tasks to create crew and team workload**

- **Activities:**
  - Identify crew/team guidelines
  - Develop crew/team concepts and designs
  - Identify additional crew/team specific tasks

***Products*: Crew/team requirements and revised task list**

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Step 8 - Performance, Workload and Training Level Estimation

- **Analytic phase for human system performance and human resource requirements**

- **Activities/Products:**
  - Estimate individual physical and cognitive workload
  - Estimate individual performance levels
  - Estimate crew/team workload
  - Establish training concepts
  - Evaluate human performance

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Step 8 - Performance, Workload and Training Level Estimation (Continued)

- **Activities/Products:**
  - Estimate selection criteria
  - Evaluate human workload
  - Estimate manpower requirements
  - Evaluate training concepts
  - Estimate training requirements
  - Identify high drivers
  - Conduct tradeoff analysis

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Step 9 - Training System Requirements Analysis (TSRA)

- **Based on DoD's Instructional Systems Development (ISD) and SE processes**

- **Activities/Products:**
  - Conduct training situation analysis
  - Identify/assess training system alternatives
  - Conduct training media analysis
  - Conduct fidelity analysis
  - Develop training system functional description (TSFD)

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Step 10 - User and Requirements Review

- **Review user human performance requirements and ability to meet user requirements as system evolves**

- **Activities:**
  - Testing/modeling to confirm predicted performance levels
  - Audits against human performance requirements and specifications
  - Sensitivity analyses to identify human performance and design alternatives
  - Tradeoff analyses to assess alternatives

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TDFA and TEMP

- **TEST DESIGN**
  - Performance Requirements
  - Conditions
  - Scenarios
  - Human System Interface
  - METLs
  - Team/Crew Definition
- **MEASUREMENT CRITERIA**
  - MOP
  - MOE
- **TEST PLANNING**
  - Personnel Selection Requirements
  - Training Requirements
  - Manpower Requirements
- **TEST EVALUATION**
  - Human Performance Requirements
  - Mission-Based Performance Criteria

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